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Original Article

Perception is a function of action: the sunset of computational metaphor and its implications for teaching of Physical Education

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Abstract

According to the latest scientific perspective, mechanisms specialized in action-oriented visuospatial perception and processing involve cognitive mechanisms, or, if preferred, "the brain uses a spatial language" (Berthoz, 2011). Environment and space, in this view, cannot be separated, according to the work of Merleau-Ponty(M. Merleau-Ponty, 1962), from the perceiver: You can know reality only in experiential learning.Perception, in this perspective, is not a moment separate from action in an algorithmic process (perception-elaboration-action) but is part of action, indeed, it is a function of action. There is no perception, there is no vision of the world that does not refer to the moving body in space.More precisely, the body in action resolves complexity in a process of perception-action which, according to the most recent findings of neuroscience, is reversed with respect to the cognitivist paradigm. Leman (Leman, 2008) summarizes: “what happens in perception can be understood in terms of action”.

We participate to a reversal of the classical description of the mechanisms of perception and action that places the intentional and goal-oriented subject at the origin of the process. The subject builds his world according to his basic needs and action tools.

From the educational point of view, this leads to the disintegration of cognitivist methodological model, based on a concept of information-processing that underlies the perception-action stages as a discrete, separate and non-overlapping stages. This model, which is still dominant in the practice of Physical Education teaching, results in a fragmentation of the action, divided into sequential stages, according to the practices of the partial exercise, randomized exercise and varied exercise. This behaviorist / cognitivist idea of teaching is immediately understandable because it focuses its attention to the relationship between teaching and observable performance, studying the teaching strategies capable of producing feedback that may increase the likelihood of a result or replicate or improve performance.

Key words: *physical education, evaluation, gymnastics, primary school, curriculum.*

Introduction

In Physical Education, this causes that teachers often fail to see the relevance of theory for their work or studies, typically expressing a preference for practical, hands-on learning/teaching, which they consider more useful. However, all teaching is based upon some sort of theory about how we learn. Typically, it is underpinned by commonsense beliefs about learning that are rarely articulated or questioned.

The implicit, behaviorist / cognitivist, learning theory that operates in the teaching practice reduces learning to a simple linear process based on a conception of learning as a process of internalizing preexisting external knowledge. It draws on the analogy of a machine to break learning down into a multitude of components. From this perspective, knowledge is conceived of as a preexisting, “out there” entity and learning as being a process of internally representing this reality in the mind of the learner. In Physical Education, this is evident in the teaching of predetermined “fundamental” motor skills seen as being a prerequisite for playing games and sport.

Taking into account the cited reversal of perception-action paradigm implies to consider a very different epistemology, or conception of knowledge, to adopt a more ecological, holistic view of learning that challenges the dualistic division of mind from body, learner from learned, and subject from object. For researchers in the Physical Education field, the reversal of the perception-action paradigm and the sunset of computational metaphor provides a promising means of reconceptualizing the teaching of physical education and its place in the curriculum.

Personal epistemology in teaching and learning motor skills

All teaching is based upon some sort of theory about how we learn. Typically, it is underpinned by commonsense beliefs about learning that are rarely articulated or questioned.

This implicit learning theory or personal epistmology operates in the teaching practice and reduces learning to a simple linear process of internalizing preexisting external knowledge.

“Although physical education teachers may not necessarily articulate clear beliefs about it, their practice invariably rests upon basic, unquestioned beliefs about learning. Their practice is typically based upon

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assumptions about learning that are deeply embedded in Western culture (Davis, Sumara, & Luce-Kapler, 2000) and that assume it to be an explicit linear and measurable process of internalizing knowledge" (Light, 2008)

Learning, in this perspective, draws on the analogy of a machine to break learning down into a multitude of components. From this point of view, knowledge is conceived of as a preexisting, "out there" entity and learning as being a process of internally representing this reality in the mind of the learner. In Physical Education, this is evident in the teaching of predetermined "fundamental" motor skills seen as being a prerequisite for playing games and sport.

This approach has been theorized by scholars linked to cognitive theory:

"motor learning is an internal process that reflects the level of individual ability and performance and could be evaluated according to the relative stability of the executions of a task" (Schmidt & Wrisberg, 2008).

As a result, teaching of motor activity will be prescriptive, by administering to the student exercises to stabilize the motor program and minimize the variability of execution. (Di Tore, Discepolo, & Di Tore, 2013). Teaching method of cognitive approach is, traditionally, based on tutorials. Blocked and random practices, as well as partial practice and feedback administration techniques are typical of this approach:

"An important question confronting the learner or instructor is how to sequence the practice at these various tasks during the practice session so as to maximize learning. Two variations have powerful effects on learning: blocked and random practice. Suppose that your student has three tasks (tasks A, B, and C) to learn in a practice session and that these tasks are fundamentally different, such as tennis serves, volleys, and ground strokes. That is, tasks are chosen such that one cannot argue that any of them are in the same class or use the same GMP. A commonsense method of scheduling such tasks would be to practice all trials of one task before shifting to the second, then to finish practice on the second before switching to the third. This is called blocked practice, in which all the trials of a given task (for that day) are completed before moving on to the next task. Blocked practice is typical of some drills in which a skill is repeated over and over, with minimal interruption by other activities. This kind of practice seems to make sense in that it allows the learners to concentrate on one particular task at a time and refine and correct it. Another practice scheduling variation is called random (interleaved) practice; where the order of task presentation is mixed, or interleaved, across the practice period. Learners rotate among the three sample tasks so that, in the more extreme cases, they never (or rarely) practice the same task on two consecutive attempts. And from a common-sense perspective, the random method, with its high level of trial-to-trial variability, its high level of contextual interference would not seem optimal for learning" (Schmidt & Lee, 1988, 2013)

Movements with a great level of difficulty and the high degrees of complexity, can be simplified by dividing the exercises in little part or reducing the need for speed precision. In this theoretical framework, fragmentation, segmentation and simplification do not adversely affect the deep structure of the generalized motor program.

This approach is consistent with a theoretical model of Human Information Processing that includes discrete and non-overlapping stages (Di Tore, Discepolo, & Di Tore, 2013; Di Tore, 2015). The discrete sequence *Stimulus identification - Response Selection - Response programming*, according to which the cognitive psychology describes the mechanism of perception – action (Schmidt & Wrisberg, 2008), faithfully repeats, in fact, the IPO model (input - processing - output).

"In essence, this model is functional in an interaction that considers space and time as separate elements, consistent with a conception of time as somethingmoving with respect to a static observer, a linear path from A to B in which to place our body" (P. A.Di Tore et al., 2013).

"The idea of inputting information and then processing it before acting upon it is easy to follow and makes learning in games look relatively straightforward. Information processing, however, is based on assumptions that knowledge is external to the learner. It does not take into account human experience and the ways in which perception is shaped by, and interacts with, the individual's life experiences. Information processing assumes knowledge as a given object independentof human experience" (Light, 2008).

Instead, according to a motor theory of perception, perception is not a passive mechanism for receiving and interpreting sensory data but is the active process of anticipating the sensory consequences of an action and thereby binding the sensor and motor patterns in a coherent framework.

This is a view that recalls Helmotz corollary discharge,Piaget's circular reaction, and Bernstein's comparator model. All these perspectives share an idea of ecological nature of motor control, of a partnership between brain processes (including muscles) and world dynamics.

Perception, therefore, is more than merely a biological function of the body. Processes of perception involve interpretation shaped by experience (Varela, Thompson, &Rosch, 1992). The preschool child learns through his or her eyes, ears, tactile sensations and combinations of senses (including thinking), and nonverbal social interaction well before the development of language. This learning involves the use of "organs of the process of doing something from which meaning results"(Dewey, 1916).

Recent literature has shown how the action does not just react to the event, but anticipates it through simulation or emulation (Decety& Jackson, 2004; Jeannerod, 1994; R.R. Llinás, 2009; Prinz&Hommel, 2002; Di Tore, Di Tore, Mangione, Corona&ConesaCaralt, 2014).The model of Human Information Processing, in fact, falters:

"the brain does not actually compute anything, not in the sense of the algorithmic handling of ones and zeros that characterizes Alan Turing's digital "universal computer" (R. R. Llinás, 2002).

In such vision, there is no reason to find the boundaries between mind and environment. Human brain is not a computer, rather it's an emulator (a reality emulator, according to Llinás) which is at the origin of perception – action process (that is, an intentional, goal-oriented process), recalling an intuition from Merleau-Ponty: "the world cannot be separated from the perceiver" (Merleau-Ponty, 1962). The French phenomenologist suggests that perception is an interpretative act that involves, not passive reception of information, but active projection of the agent's experience. What is perceived and how it is interpreted varies according to the agent's accumulated experiences. The world does not exist in some pure form completely separate from us but instead exists as we perceive it (Light, 2008; Merleau-Ponty, 1962) or, in other words, what happens in perception can be understood in terms of action (Leman, 2008).

In such an approach, motor learning is a question of the adaptability of the movement, matching the diversity of the environment and the specificity of the individual (Carnus, 2010).

According to this perspective, mechanisms specialized in action-oriented visuospatial perception and processing are the basis cognitive mechanisms, or, if preferred, "the brain uses a spatial language" (A. Berthoz, 2011a).

The basic hypothesis is that "the mental tools elaborated during evolution to solve the many problems posed by the need to advance into space have also been used for the higher cognitive functions: memory and reasoning, relationship with others and also creativity (A. Berthoz, 2011b).

The brain, in this perspective, it is very far from the idea of processor of stimuli coming from the senses, but is a creator of worlds, a reality emulator. Our reality emulator acts primarily as the prerequisite for coordinated, directed motricity; it does so by generating a predictive image of an event to come that causes the creature to react or behave accordingly (Llinás, 2002).

A position, this, that Llinás does not hesitate to describe as "a brain-centric perspective", in which the brain is not an open system […] that accepts inputs from the environment, processes them, and returns them to the world reflexively regardless of their complexity", but is a "closed system modulated by the senses, a self-activating system, whose organization is geared toward the generation of intrinsic images, capable of emulating reality (generating emulative representations or images) even in the absence of input from such reality, as occurs in dream states or daydreaming. From this one may draw a very important conclusion. This intrinsic order of function represents the fundamental, core activity of the brain. This core activity may be modified (to a point!) through sensory experience and through the effects of motor activity" (Llinás, 2002).

Environment, cannot be separated, according to the work of Merleau-Ponty(Merleau-Ponty, 1962), from the perceiver: You can know reality only in experiential learning.

Perception, here, is not a moment separate from action in an algorithmic process (perception-elaboration-action) but is part of action, indeed, it is a function of action. There is no perception, there is no vision of the world that does not refer to the moving body in space.

More precisely, the body in action resolves complexity in a process of perception-action which, according to the most recent findings of neuroscience, is reversed with respect to the cognitive paradigm.

In short , we are participating to a "reversal of the classical description of the mechanisms of perception and action that places the intentional and goal-oriented subject at the origin of the process. The subject builds his world according to his basic needs and action tools. This view has also been promoted by Bergson and Husserl"(A. Berthoz, 2008).

Umwelt

Umwelt is the term used by von Uexküll(von Uexküll, 1934) to indicate the "perceptual world".

Animals and humans are [...] prisoners of a specific repertoire of possible perceptions of their Umwelt. This term [...] indicates that the animal makes use of their environment, and not vice versa. In fact Uexküll believes that living organisms are constituted by a set of components that originate everything by combining, but which are structured from an aim, a real intention that determines the parts in a centrifugal manner, and not centripetal. It is the action that gives meaning to the artifacts in the sense of "art products": objects, tools, man-made machines. [...] The meaning is always given by the act that we are going to accomplish with the object, which simplifies its perception and especially organizes the world. Uexküll distinguishes two types of perceptual processes. The first is related to sensible experience, that records in memory the signals received in a sequence of actions in the real world (for example the memory of a trip into town), and are thus mediated by the senses.

The second, however, is innate in the sense that the appearance of the world would be given in an almost "magical" way [...]. In the case of their Umwelt, animals can create imaginary worlds that Uexküll defines "magical", that allow a predictive behavior(Alain Berthoz, 2014).

Umwelt includes the world of things in the environment, the perceived world, the signals emitted from the subject is that by the objects, and actions that can be performed by each species. Above all, it includes the meaning of objects for each subject, to the extent that participate in the survival relationships and social relationships of the subject. In describing the umwelt of the dog, Uexküll paints (literally) a room, whose chairs and whose dishes on the table are significant elements in the canine world, unlike textbooks that are wholly irrelevant. The dog has an idea in mind, an image search.

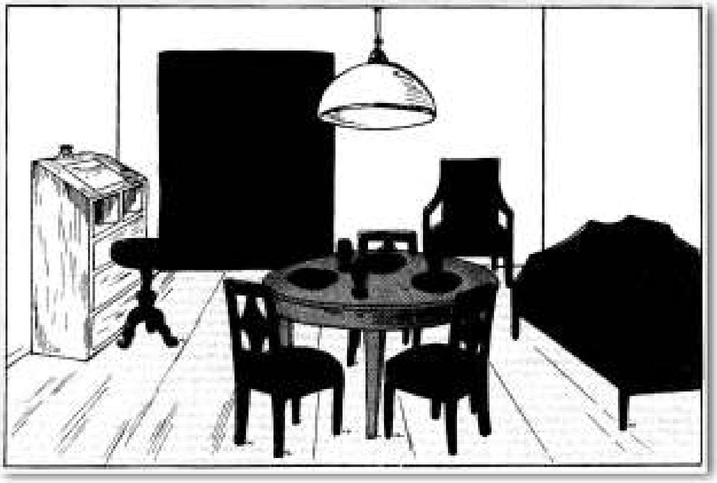

Fig. 1 - The room in terms of functional tones connected with its object by a dog

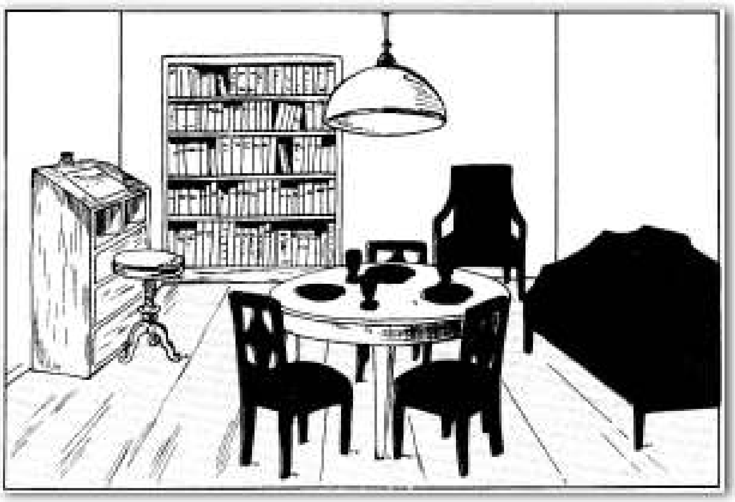

Fig. 2 - The room in terms of functional tones connected with its object by man[1]

"All the characteristics of the objects are in fact nothing other than the perceptive characters that are attributed to them by the subject with whom they have a relationship" (von Uexküll, quoted in Berthoz, 2008). The umwelt is, therefore, a dynamic, interactive concept that defines the relations between the physical world and living organisms, and constitutes the basis and the assumption of intersubjectivity(A. Berthoz, 2009), an interface in which "the significance is conferred by the Act of the subject (von Uexküll & Müller, 2004).

The subject builds up his world in accordance with his basic necessities and his tools of action, in a perspective which recalls Bergson and the phenomenological tradition attributable to Husserl and Merleau-Ponty, in the concept of enlacement proposed by Varela (Varela, Thompson, & Rosch, 1992), as in Von Foerster's second-order cybernetics idea, up to, on another plane, at the Mille Plateaux of Deleuze and Guattari(Deleuze & Guattari, 2003).

In Uexküll as in Varela and Von Foerster it is possible to re-trace the roots of a bio-constructivism, which includes all living systems, psychological systems and social systems upstream of the different conceptualizations, and which has difficulty in establishing a common universe precisely because, When these authors write of "reality," they refer to not a universe, but a multiverse. Learning, as a fundamental strategy for facing complexity, is a peculiar adaptive process the living being, which develops in the umwelt. Cognitive skills can be considered as the result of evolutionary adaptations to an extremely small segment of the world as it is known to us today (Singer, 2009).

We should think about learning environments in terms of the students' umwelten, because these contain the structures that students perceive and act towards. It is these umwelten that change as students interact with their peers, teachers, and material structures (Roth & Lawless, 2002)

From theory to practice

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[1]from von Uexküll, J., & von Uexküll, T. (1992). *Jakob Von Uexküll's A Stroll Through the Worlds of Animals and Men*: Mouton de Gruyter.

The moving body and the process of perception - action have been object, in recent decades, of attention that goes beyond the disciplinary boundaries of Physical Education and sports sciences. However, the teaching practices common in schools, from kindergarten to high school, are still bound to a theoretical framework that looks outdated or appear related to personal epistemology of teachers and educators. Yet, in schools, from kindergarten to high school, teaching practices appear to be more related to the cognitive approach, when they not directly descend from a behaviorist framework. It is important to emphasize how theories of knowledge (especially the behaviorist and cognitivist theories, borrowed from the psychology domain), have shown, historically, a good contiguity with the practical problems of educators (Davis & Sumara, 2003).

In movement education, behaviorist idea of teaching is immediately understandable because it focuses its attention to the relationship between teaching and observable performance, and suggests teaching strategies capable of replicating or improving performance. In the same way, cognitive perspective promotes aninstructional design based on the individual characteristics and on the personal dimension. These two models share an idea of immediately observable performance, and produce a continuity in teaching practices (D'Isanto, 2016, Altavilla & Di Tore, 2016; Gaetano, 2012; Raiola, 2015; Raiola, Tafuri, & Gomez Paloma, 2014)

The new transdisciplinary framework that acnowledges the centrality of the body and of the movement, instead,can not be taken without mediation in teaching practices and, in this particular case, involves all the traditional educational system, from didactic methods to assessment. However, we reiterate that some practices destitute of scientific basis must be abandoned as soon as possible, by relocating to the center of the teaching activity the unitary structure perception / action. From this perspective, an ecological approach to teaching of movement and sport appears to be more up to date concerning the evidences from scientific research.

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